CRJ-700 Alerting Issues – Pitot/static/air data computer system failure

1. Initiating Condition: Blocked pitot source (captain's or left source)

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/ suppressed or when cue is masked	How alert or cue is terminated
Visual Alerts	Master caution light, flashing amber	Yellow EICAS message "EFIS COMP MON"			None	Pressing the master caution switchlight will stop flashing
	"EFIS COMP MON" amber message on EICAS	When difference between the Capt's and F/O's airspeed is more than 10 kts.	Crew needs to look at PFD to be sure they understand which EFIS comparator value is being flagged.		None	Switching to the ADC on the operative side
	Capt's. airspeed tape shows an amber IAS in a box parallel to the tape	When difference between the Capt's and F/O's airspeed is more than 10 kts.			None	Switching to the ADC on the operative side
	On the PFD, "ADC 1 or 2" displayed in amber letters	Single ADC operation		Single ADC loss will render stick pusher inactive. Shaker will still be functional		Both ADC's operating correctly
	The following status messages will be displayed after switching to correct ADC: L FADEC FAULT (1 OR 2), SPLR/STAB FAULT, RUD LIMIT FAULT	Single ADC operation				Both ADC's operating correctly
Aural Alerts	Master caution message single chime	Yellow EICAS message "EFIS COMP MON"				None, only a single chime, does not repeat unless another caution message is presented.

CRJ-700 Alerting Issues – Pitot/static/air data computer system failure

1. Initiating Condition: Blocked pitot source (captain's or left source) – Cont.

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/suppressed or when cue is masked	How alert or cue is terminated
Tactile Alerts	None					
Visual Cues	Significant deviations between the airspeed readings on the Capt's./F/O's/Standby indicators					Switching to the ADC on the operative side
Aural Cues	None					
Tactile/ Somatic Cues	None					

Expected Pilot Response(s)

- Adjust airplane attitude and thrust to maintain aircraft control
- Follow QRH procedures to switch ADC to operable side
- RVSM altitudes no longer allowed. Hence, lower altitudes must be used which may affect fuel burn and range. Consideration for fuel stop must be considered.
- Cat II operations may be affected and destination choices may have to be altered.
- Switch FD and transponder to side with operative ADC

Possible sources of confusion with regard to pilot response(s)

- It is possible that a pilot would follow erroneous airspeeds and place the aircraft in dangerous situation such as overspeed. This is unlikely, though, because the faulty side will show the IAS message against the airspeed tape, showing the untrustworthy side
- If climbing in speed mode and airspeed becomes untrustworthy, it is possible that the autopilot will follow the untrustworthy indications
- Windshear guidance is available only on the pilot's side where the correct or operable ADC is located

How does pilot know condition is resolved/recovered?

- After selection of ADC on correct side the "EFIS COMP MON" EICAS message will be removed, as will the amber IAS on the airspeed tape

CRJ-700 Alerting Issues – Pitot/static/air data computer system failure

2. Initiating Condition: Blocked pitot sources (all sources blocked, first partially and inconsistently, then completely), with ram air pressure trapped in at least one pitot system during climb (e.g., blocked pitot drain)

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/ suppressed or when cue is masked	How alert or cue is terminated
Visual Alerts	Master caution light, flashing amber	Yellow EICAS message "EFIS COMP MON"	This message will disappear and would normally be indicative of a solved problem, however, the message will also disappear when the airspeeds go to zero	This will be temporary as any differences beyond the 10 kts. is detected. May come and go as "EFIS COMP MON" is presented and removed.	None	Pressing the master caution switchlight will stop flashing
	"EFIS COMP MON" amber message on EICAS	When airspeed between the capts and F/Os is more than 10 kts.	Crew needs to look at PFD to be sure they understand which EFIS comparator value is being flagged.	This will be temporary as any differences beyond the 10 kts. is detected. May come and go depending on the blockage and differences in perceived airspeed.	None	When the airspeeds either are within 10 kts and/or they reach zero the alert will terminate.
	Airspeed tape, altitude tape, and vertical speed indicator all disappear and are replaced with red IAS, ALT and V/S flags respectively as the ADC are interpreted to have failed (really because of blockage)	ADC are determined to no longer be functioning and providing data to displays		With both ADCs considered inoperative, neither the stick shaker or pusher will be operational		Switching to the ADC on the operative side if only one ADC failure is currently shown. However, with all three pitot input sources blocked, both ADCs will be interpreted to have failed.

CRJ-700 Alerting Issues – Pitot/static/air data computer system failure

2. Initiating Condition: Blocked pitot sources (all sources blocked, first partially and inconsistently, then completely), with ram air pressure trapped in at least one pitot system during climb (e.g., blocked pitot drain) – Cont.

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/ suppressed or when cue is masked	How alert or cue is terminated
Visual Alerts	The following EICAS caution messages are displayed; MACH TRIM, RUD LIMITER, STALL FAIL, AUTO PRESS. The following status messages are displayed when both ADC are interpreted to have failed: GPWS FAIL, WINDSHEAR FAIL, L and R FADEC FAULT 2, SPLR/STAB FAULT, RUD LIMIT FAULT	Both ADCs are interpreted by the system to have failed due to the blockage.		With both ADCs considered inoperative, there will be a "slight" difference between the Capts and F/Os altimeters		Both ADC's operating correctly
	On the PFD, both "ADC 1 and 2" will be displayed in amber letters	Both ADCs are interpreted by the system to have failed due to the blockage.		GPS will go off line and stop comparing latitude.		Both ADC's operating correctly
	Stall push light switch on glareshield will illuminate	Predetermined angle of attack (AOA) is reached or predicted to be reached.	Stall warning may be valid if aircraft enters stall condition during loss of control while following incorrect airspeed references, but may not be considered to be valid by the pilots because of simultaneously			Reduction of AOA

CRJ-700 Alerting Issues – Pitot/static/air data computer system failure

2. Initiating Condition: Blocked pitot sources (all sources blocked, first partially and inconsistently, then completely), with ram air pressure trapped in at least one pitot system during climb (e.g., blocked pitot drain) – Cont.

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/ suppressed or when cue is masked	How alert or cue is terminated
			displayed conflicting (high) airspeed and overspeed warnings (due to pitot system(s) in which the ram air pressure is trapped). Resolution of the discrepancy requires effortful reference to standby airspeed display and/or to pitch/power displays; Pilots may follow incorrect airspeed guidance into an undesired aircraft state or loss of control, because the airspeed display may appear valid and the process of identifying the discrepant display(s) may			

CRJ-700 Alerting Issues – Pitot/static/air data computer system failure

2. Initiating Condition: Blocked pitot sources (all sources blocked, first partially and inconsistently, then completely), with ram air pressure trapped in at least one pitot system during climb (e.g., blocked pitot drain) – Cont.

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/ suppressed or when cue is masked	How alert or cue is terminated
			require substantial time			
Aural Alert	Auto-pilot disconnect cavalry charge will occur with stick shaker activation causing the green "AP" on PFD to change to red then disappear	Predetermined angle of attack (AOA) is reached or predicted to be reached.	Stall warning may be valid if aircraft enters stall condition during loss of control while following incorrect airspeed references, but may not be considered to be valid by the pilots because of simultaneously displayed conflicting (high) airspeed and overspeed warnings (due to pitot system(s) in which the ram air pressure is trapped). Resolution of the			None, will flash twice then red "AP" will disappear from PFD

CRJ-700 Alerting Issues – Pitot/static/air data computer system failure

2. Initiating Condition: Blocked pitot sources (all sources blocked, first partially and inconsistently, then completely), with ram air pressure trapped in at least one pitot system during climb (e.g., blocked pitot drain) – Cont.

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/ suppressed or when cue is masked	How alert or cue is terminated
			discrepancy requires effortful reference to standby airspeed display and/or to pitch/power displays; Pilots may follow incorrect airspeed guidance into an undesired aircraft state or loss of control, because the airspeed display may appear valid and the process of identifying the discrepant display(s) may require substantial time			
Aural Alerts	Master caution message single chime	Yellow EICAS message "EFIS COMP MON"				None, only a single chime, does not repeat unless another caution message is presented.

CRJ-700 Alerting Issues – Pitot/static/air data computer system failure

2. Initiating Condition: Blocked pitot sources (all sources blocked, first partially and inconsistently, then completely), with ram air pressure trapped in at least one pitot system during climb (e.g., blocked pitot drain) – Cont.

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/ suppressed or when cue is masked	How alert or cue is terminated
	Overspeed clacker will not be present with both ADC's inoperative	Associated with indicated airspeed greater than 3 knots faster than Vmo/Mmo, because either (1) pressure is trapped in a pitot system by blockage and ambient pressure decreases in the climb; or (2) pilot follows a different airspeed display that is reading an incorrectly low value into a true overspeed.	It may not immediately be evident to the pilots whether this is a true or false warning, especially in the presence of inconsistent airspeed displays	Despite airspeed possibly going into the overspeed band on the A/S tape, if both ADCs are out, the overspeed clacker will not trigger		Alert terminates when indicated airspeed is reduced to at least 3 knots slower than Vmo/Mmo
Aural Alerts	Stick shaker (sound of)	Predetermined angle of attack (AOA) is reached or predicted to be reached.	Stall warning may be valid if aircraft enters stall condition during loss of control while following incorrect airspeed references, but may not be		Based on system design, the stall warning system and related alerts are inhibited when all ADC inputs are blocked/invalid, so this alert may start and stop unexpectedly as pitot sources block	Reduction of AOA

CRJ-700 Alerting Issues – Pitot/static/air data computer system failure

2. Initiating Condition: Blocked pitot sources (all sources blocked, first partially and inconsistently, then completely), with ram air pressure trapped in at least one pitot system during climb (e.g., blocked pitot drain) – Cont.

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/ suppressed or when cue is masked	How alert or cue is terminated
			considered to be valid by the pilots because of simultaneously displayed conflicting (high) airspeed and overspeed warnings (due to pitot system(s) in which the ram air pressure is trapped). Resolution of the discrepancy requires effortful reference to standby airspeed display and/or to pitch/power displays; Pilots may follow incorrect airspeed guidance into an undesired aircraft state or loss of control, because the airspeed display may appear valid		and unblock	

CRJ-700 Alerting Issues – Pitot/static/air data computer system failure

2. Initiating Condition: Blocked pitot sources (all sources blocked, first partially and inconsistently, then completely), with ram air pressure trapped in at least one pitot system during climb (e.g., blocked pitot drain) – Cont.

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/ suppressed or when cue is masked	How alert or cue is terminated
			and the process of identifying the discrepant display(s) may require substantial time			
	Stall warbler	Predetermined angle of attack (AOA) is reached or predicted to be reached.	Stall warning may be valid if aircraft enters stall condition during loss of control while following incorrect airspeed references, but may not be considered to be valid by the pilots because of simultaneously displayed conflicting (high) airspeed and overspeed warnings (due to pitot system(s) in which the ram air pressure is		Based on system design, the stall warning system and related alerts are inhibited when all ADC inputs are blocked/invalid, so this alert may start and stop unexpectedly as pitot sources block and unblock	Reduction of AOA

CRJ-700 Alerting Issues – Pitot/static/air data computer system failure

2. Initiating Condition: Blocked pitot sources (all sources blocked, first partially and inconsistently, then completely), with ram air pressure trapped in at least one pitot system during climb (e.g., blocked pitot drain) – Cont.

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/ suppressed or when cue is masked	How alert or cue is terminated
			trapped). Resolution of the discrepancy requires effortful reference to standby airspeed display and/or to pitch/power displays; Pilots may follow incorrect airspeed guidance into an undesired aircraft state or loss of control, because the airspeed display may appear valid and the process of identifying the discrepant display(s) may require substantial time			

CRJ-700 Alerting Issues – Pitot/static/air data computer system failure

2. Initiating Condition: Blocked pitot sources (all sources blocked, first partially and inconsistently, then completely), with ram air pressure trapped in at least one pitot system during climb (e.g., blocked pitot drain) – Cont.

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/ suppressed or when cue is masked	How alert or cue is terminated
	Auto-pilot disconnect cavalry charge sound	Stick shaker activation				none, will sound once and stop
Tactile Alerts	Stick shaker	Predetermined angle of attack (AOA) is reached or predicted to be reached.	Stall warning may be valid if aircraft enters stall condition during loss of control while following incorrect airspeed references, but may not be considered to be valid by the pilots because of simultaneously displayed conflicting (high) airspeed and overspeed warnings (due to pitot system(s) in which the ram air pressure is		Based on system design, the stall warning system and related alerts are inhibited when all ADC inputs are blocked/invalid, so this alert may start and stop unexpectedly as pitot sources block and unblock	Reduction of AOA

CRJ-700 Alerting Issues – Pitot/static/air data computer system failure

2. Initiating Condition: Blocked pitot sources (all sources blocked, first partially and inconsistently, then completely), with ram air pressure trapped in at least one pitot system during climb (e.g., blocked pitot drain) – Cont.

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/ suppressed or when cue is masked	How alert or cue is terminated
			trapped). Resolution of the discrepancy requires effortful reference to standby airspeed display and/or to pitch/power displays; Pilots may follow incorrect airspeed guidance into an undesired aircraft state or loss of control, because the airspeed display may appear valid and the process of identifying the discrepant display(s) may require substantial time			

CRJ-700 Alerting Issues – Pitot/static/air data computer system failure

2. Initiating Condition: Blocked pitot sources (all sources blocked, first partially and inconsistently, then completely), with ram air pressure trapped in at least one pitot system during climb (e.g., blocked pitot drain) – Cont.

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/suppressed or when cue is masked	How alert or cue is terminated
Visual Cues	Significant deviations between the airspeed readings on the Capt's./F/O's/Standby indicators; All of these will go to zero as the pressure in the system is decreased.					Switching to the ADC on the operative side
Aural Cues	None					
Tactile/ Somatic Cues	Aerodynamic buffet	Actual overspeed or approach to stall	Not definitive as to cause, may suggest either high or low speed excursion			

Expected Pilot Response(s)

- Follow QRH procedures to switch ADC to operable side when the event begins. However, as both ADCs are believed to have failed, the QRH re-directs the crew to focus on manual cabin pressurization.
- Adjust airplane attitude and thrust to maintain aircraft control
- Follow QRH procedures to Accomplish "Manual Cabin Pressurization Control Procedure"
- RVSM altitudes no longer allowed. Hence, lower altitudes must be used which may affect fuel burn and range. Consideration for fuel stop must be considered.
- Cat II operations will be affected and destination choices may have to be altered.
- Will not be able to switch FD and transponder to side with operative ADC as there both have failed

Possible sources of confusion with regard to pilot response(s)

- If climbing in speed mode and airspeed becomes untrustworthy, it is possible that the autopilot will follow untrustworthy indications
- Many caution messages and status messages can be very confusing and may distract the crew from flying the aircraft in addition to the challenge of deciding which QRH procedure to follow first.

CRJ-700 Alerting Issues – Pitot/static/air data computer system failure

2. Initiating Condition: Blocked pitot sources (all sources blocked, first partially and inconsistently, then completely), with ram air pressure trapped in at least one pitot system during climb (e.g., blocked pitot drain) – Cont.

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/suppressed or when cue is masked	How alert or cue is terminated

- With both ADCs being flagged as failed, pilot might try to follow stand-by airspeed; however, that will be invalid as well.
- If the aircraft is flown into an actual overspeed condition with all air data inputs missing or invalidly low, the expected overspeed warnings will be absent. The absence of an expected warning can be confusing and inhibit pilots' identification of the overspeed condition.
- If aircraft is flown into actual stall condition with both ADCs failed due to loss of input data, both stall warning systems will be inoperative and the expected stall warning will not be provided to the pilots. In this event, the absence of an expected cue can be confusing, and the pilots may not identify other stall cues (e.g., uncommanded roll) as being related to a stall.
- The "EFIS COMP MON" message will disappear and would normally be indicative of a solved problem, however, the message will also disappear when the airspeeds go to zero

CRJ-700 Alerting Issues – Pitot/static/air data computer system failure

2. Initiating Condition: Blocked pitot sources (all sources blocked, first partially and inconsistently, then completely), with ram air pressure trapped in at least one pitot system during climb (e.g., blocked pitot drain) – Cont.

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/suppressed or when cue is masked	How alert or cue is terminated

How does pilot know condition is resolved/recovered?

- The tapes and indicators will be returned and red IAS, ALT and/or V/S will be removed if the occlusion is removed.

Issues with regard to multiple concurrent non-normal conditions

- It will not be obvious that GPS is now off-line and system will revert to DME-DME processing of navigation solutions. Implications for NextGen operations and the types of procedures accepted after this type of failure.

CRJ-700 Alerting Issues – Pitot/static/air data computer system failure

3. Initiating Condition: Air data computer failure (single module or unit)

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/suppressed or when cue is masked	How alert or cue is terminated
Visual Alerts	Master caution light, flashing amber	Yellow EICAS message "EFIS COMP MON"			None	Pressing the master caution switchlight will stop flashing
	"EFIS COMP MON" amber message on EICAS	When difference between the Capt's and F/O's airspeed is more than 10 kts.	Crew needs to look at PFD to be sure they understand which EFIS comparator value is being flagged.		None	Switching to the ADC on the operative side
	Airspeed tape, altitude tape, and vertical speed indicator all disappear and are replaced with red IAS, ALT and V/S respectively	ADC no longer functioning and providing data to displays				Switching to the ADC on the operative side
	The following EICAS status messages will be displayed after switching to correct ADC: L FADEC FAULT (1 OR 2), SPLR/STAB FAULT, RUD LIMIT FAULT	Single ADC operation				Both ADC's operating correctly
	On the PFD, "ADC 1 or 2" will be displayed in amber letters	Single ADC operation				Both ADC's operating correctly
Aural Alerts	Master caution message single chime	Yellow EICAS message "EFIS COMP MON"				None, only a single chime, does not repeat unless another caution message is presented.

CRJ-700 Alerting Issues – Pitot/static/air data computer system failure

3. Initiating Condition: Air data computer failure (single module or unit)

Type	Alert or cue	Threshold for alert or cue to be presented	Confusion regarding alert or cue	Other issues with regard to alert or cue	When alert is inhibited/suppressed or when cue is masked	How alert or cue is terminated
Tactile Alerts	None					
Visual Cues	Significant deviations between the airspeed readings on the Capt's./F/O's/Standby indicators					Switching to the ADC on the operative side
Aural Cues	None					
Tactile/ Somatic Cues	None					

Expected Pilot Response(s)

- Adjust airplane attitude and thrust to maintain aircraft control
- Follow QRH procedures to switch ADC to operable side
- RVSM altitudes no longer allowed. Hence, lower altitudes must be used which may affect fuel burn and range. Consideration for fuel stop must be considered.
- Cat II operations may be affected and destination choices may have to be altered.
- Switch FD and transponder to side with operative ADC

Possible sources of confusion with regard to pilot response(s)

- It is possible that a pilot would follow erroneous airspeeds and place the aircraft in a dangerous situation, such as overspeed; however, this is unlikely because the faulty side will show the IAS message against the airspeed tape, showing the untrustworthy side
- If climbing in speed mode and airspeed becomes untrustworthy, it is possible that the autopilot will follow untrustworthy indications
- Windshear guidance is available only on the pilots side where the correct or operable ADC is located

How does pilot know condition is resolved/recovered?

- After selection of ADC on correct side the airspeed & altitude tapes in addition to the vertical speed indicator will return